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Abstract

TECHNICAL OBJECTIVES OF THE VULCAIN REACTOR PROJECT

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For several years there has been much interest in the use of D_2O/H_2O moderators in pressurised water reactors, giving improved neutron economy, and hence lower fuel costs. A method of employing this principle, giving a varying degree of moderation, and hence reactivity, throughout core life was suggested in 1957 for the Vulcain reactor, and is being developed through a series of experiments as part of a joint research programme between Belgonucleaire (supported by the Belgian Government and Centre d'Etudes Nucleaire) and the United Kingdom Atomic Energy Authority.

In addition to the target of low fuel costs, a further objective is to attain low capital costs by developing a compact, integral type water reactor with inherent load following characteristics. This type of reactor would also be suitable for small land-based power stations. The programme includes engineering research into heat-exchanger design, integral circulating pumps, self pressurisation, water treatment and hydraulic shut-down devices. Core design and fuel element development is to be demonstrated in a power experiment in the BR 3 reactor at Mol. This, and experimental physics work, are described in other papers. The optimisation of small cores using a mixed D_2O/H_2O moderator leads to a compact highly rated

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design with low D_2O inventory. This is particularly desirable for a marine system and also minimises heavy water investment cost.

The inherent self regulating characteristics of the Vulcain core are exploited to the extent that it is possible to dispense with conventional control methods for all conditions except xenon poisoning. This is provided for by soluble poison techniques embodied in the primary coolant purification system, thus eliminating mechanical control rods. Positive-acting safety rods are provided which are completely withdrawn from the core during normal operation.